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Schoster, Angelika

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**Angelika Schoster Dr.med.vet, DVSc, DACVIM, DECEIM**
**Vetsuisse Faculty University of Zurich, Switzerland**

## INTRODUCTION

Feed supplements are all substances fed to a horse in addition to a diet of forage, which technically would also include grain. However, the term is now most often used to describe additional nutrients (vitamins, minerals, extra protein, energy, herbal supplements and other neutraceuticals as well as probiotics). Neutraceuticals are defined as a food or a part of food that provides medical or health benefits, including prevention or treatment of disease. These feed supplements have become popular for the prevention or treatment of various diseases, such as gastrointestinal disease, osteoarthritis, equine gastric ulcer disease and others in recent years. Feed supplements are also promoted as performance enhancers and digestibility improvers. Many probiotic and nutraceutical formulations are available for horse owners over the counter in North America, claiming various health benefits for horses. Many contain a selection of nutrients while some only contains specific vitamins. Many horse owners administer, but also some veterinarians recommend these products based on anecdotal evidence or based on the claim on the label. Scientific, peer reviewed evidence behind these formulations is limited with only few products having been researched, with disappointing results. Additionally there is also the issue of quality control, which is not regulated by the authorities. Not only can this be a waste of money, but also dangerous, as not all products might be safe for use in horses.

In North America feed supplements are classified as neutraceuticals and are not regulated by the food and drug agency, which regulates the laws regarding food and feed safety. Probiotics for animal use are also called 'direct fed microbials' and can either be classified as a drug, in which case they have to be approved by the FDA (none currently approved for horses), or they can be classified as a dietary supplement and therefore do not need to go through the general process of drug approval. The federal government only requires that feed supplement products be labeled in a truthful and not misleading manner (www.fda.gov.com). Consequently in North America, there are numerous probiotic and feed supplements for equine use on the market, that can be obtained over the counter. Horse owners cannot assume that a product is safe and effective solely on the fact that it is produced and marketed.

## SUPPLEMENTS

Because of the myriad of products all claiming different effects it is important to understand what a specific product is designed to do. Supplements cannot replace a good feeding program, good general health management or veterinary advice and should only complement these management factors.

Feed supplements administered to horses include vitamins and minerals, substances for joint and bone maintenance, performance enhancement, hoof and coat health, immune enhancement, treatment for behavioral issues, metabolic disorders, increase in weight gain, gastrointestinal health and others. The substances used are yeasts, live-bacteria (probiotics), specific vitamins (e-g- Vitamin E), macrominerals (e.g. calcium, phosphorus, sodium, chloride, potassium), microminerals (e.g. iron, zinc, copper, manganese, selenium), extra protein, energy and others. In general these are substances owners perceive as 'missing' or inadequate in a horses diet. Some of the products have been researched however others have little or no scientific evidence.

### Probiotics and yeast

Metchnikoff first defined probiotics as 'live microorganisms which exhibit a health promoting effect' in 1908. This definition has since been modified by several authors until in 2008, the FAO and WHO defined probiotics as '*live microorganisms, that when administered orally at adequate concentrations, provide a beneficial effect beyond that of their nutritional value'*. Many reported mechanisms of action of probiotics are based on in-vitro studies only, and extrapolation of these results to in vivo conditions is controversial; however, some evidence has also been generated by in vivo studies. There are four main mechanisms of action by which probiotics exert their beneficial effect on the host:

- immune modulation of the host innate and acquired immune system
- antimicrobial production
- competitive exclusion of pathogenic bacteria
- inhibition or inactivation of bacterial toxins.

Probiotic mechanisms and effect are strain specific; therefore results from a study using a specific probiotic product cannot be extrapolated to another product.

Adverse effects of probiotic administration are rare. In humans the few reports available usually describe extra-intestinal infections, not enteric disease. There are no published reports of enteric disease in adult horses following probiotic administration[1-3]. Even when using high doses, adverse effects are not commonly seen[4]. Several published studies are also available that demonstrate safety of commercially available probiotics in foals[1,5], however one study showed that neonatal foals fed a probiotic had a higher incidence of diarrhea requiring veterinary intervention that foals fed a placebo, indicating that not all probiotics should be considered 'safe'[6]

As described earlier, manufacturers of over the counter products in North America have no obligations to perform quality control of their products. This results in most commercial veterinary probiotic preparations not being accurately represented by label claims. For example in a study by Weese et al, only 2/13 (15%) of veterinary and human probiotics contained the specified organism at the concentration propagated on the leaflet[7]. Probiotics have been evaluated as a means to treat or prevent a variety of gastrointestinal diseases in horses[4,6,8-10]. While some studies have shown some beneficial effects of probiotics, other studies could not corroborate these results. For example two studies have evaluated the efficacy of the yeast *S. boulardii* for treatment of acute enterocolitis. In one study, horses receiving *S. boulardii* had a shorter duration of diarrhea and watery diarrhea [10]. In the second study a beneficial effect could not be shown[11].

Probiotics have also been evaluated as a means to improve digestibility in several studies. Yeasts are used to improve feeding of the microbes of the hindgut to improve digestion of roughage and keep a healthier balance of microbes. While some improvement was noted for some parameters such as an increase in dry matter intake, there was limited influence on extraction of minerals from the diet in probiotic fed horses [12,13]. In each study only some of the factors were positively influenced while others remained unaffected.

Most probiotics consist of species of Lactobacilli. Recent investigations into the equine microbiome (overall bacterial population of the gastrointestinal tract) has shown that Lactobacilli only constitute a small amount of the overall population, and phyla such as Firmicutes predominate[14]. The dosages used in horses are extrapolated from human medicine, however horses are inherently different from humans and other animals as they are hind gut fermenters with an immense microbial population of their hindgut where diseases occur. It is therefore questionable whether a positive health effect can be achieved using Lactobacilli species and using the dosages currently proposed.

Overall the evidence for a positive health effect in horse for currently available probiotics is scarce. Larger scale controlled studies of different strains and products are necessary before conclusions can be drawn on the clinical efficacy of probiotics.

**Vitamins and minerals**

While supplementing vitamins can be beneficial in certain cases but over supplementation with vitamins has to be avoided as toxicities can occur. For example overfeeding of Vitamin D causes hypervitamoinosis D, a disease associated with calcification of soft tissues. Vitamin C is produced in a healthy horses liver and rarely needs to be supplemented. Vitamin B is produced by the microbes in the hindgut and supplementation should only be considered in extremely horses under extreme strenure. Vitamin E is effective as an anti-oxidant and can aid in healing of oxidative injury.

Macrominerals are most often supplemented in electrolyte supplements or due aid in bone formation (calcium and phosphorus). Salt should be made freely available to healthy horses. In cases of horses with kidney disease the recommendations of a veterinarian have to be followed.

Microminerals are mainly needed for biochemical reactions in the body but only trace amounts are needed. None of these are safe to feed free choice as toxicities can occur. Copper toxicity for example, results in fulminant renal and liver failure once toxic levels are reached. Specific regions of the US and Europa have various soil deficiencies. Knowledge of ones area is required for adequate supplementation. For example selenium deficient soil can be found in many areas over North America and Europe. Selenium is essential for muscle health. Selenium deficiency is associated with diseases such as white Muscle disease, Equine Motor Neuron Disease and Equine degenerative Myeloencephalopathy. Selenium toxicity, however, can also occur, therefore supplementation in the face of adequate contents in the diet are not recommended. Iodine deficiencies are associated with foals being born with contracted tendons.

**Joint and Bone Supplements**

Glucosamine (GS), chondroitin sulfate (CS), methyl sulfonyl methane (MSM), hyaluronic acid, silicon, soybean and avocado extract are examples of joint and bone supplements widely advertised and used in humans and horses to promote joint and bone health. Advocates propose that these supplements help the body repair cartilage. While there is in-vitro evidence that these substances have an effect on cartilage cell metabolism, there is few clinical studies evaluating an effect in the animal. A recent study evaluated the effect of a 3-month supplementation with GS, CS and MSM on improvement of stiff gait in geriatric horses in a randomized placebo controlled trial. No beneficial effect of the supplement over a placebo was seen[15]. In a recent systematic review to determine the effect of neutraceuticals on clinical signs of pain or abnormal locomotion 5 studies were reviewed. The systematic review concluded that was no effect of soybean and avocado and very weak evidence for all of the other substances evaluated. This low evidence suggest that these studies had major limitations, including used semi-subjective outcome measures[16].

**Gastrointestinal disease**

Equine gastric ulcer syndrome (EGUS) is a highly prevalent disease among performance horses. Various factors such as stress, feeding management and genetics predispose a horse to EGUS. Current treatment options are limited to medical treatment with omeprazole or histamine H2 blockers such as ranitidine and cimetidine. Treatment is expensive and required for prolonged periods of time during which the stress levels for the horse should be reduced (including high level exercise). Therefore, focus has turned to supplements as a means of preventing disease or as an adjunct treatment. Several supplements are marketed with such a health claim. Scientific evidence is limited and several recent studies have shown disappointing results. Sea Buckthorn berries and pulp were evaluated but showed only a limited effect for treatment of prevention of EGUS. Only certain types of ulcers were prevented, a treatment effect was not seen on these ulcers[17].

**Equine Metabolic syndrome (EMS)**

EMS is a recently emerging clinical syndrome of horses associated with management problems. The syndrome results from over feeding, inadequate physical activity and obesity. These factors culminate in insulin resistance and a predisposition to laminitis. Medical treatment options are limited and dietary restriction and weight loss is the mainstay of treatment. Forage should be restricted in these horses and hay is often soaked to release excessive amounts of sugar. As this practice also results in loss of minerals and vitamins, the use of forage stabilizer have been proposed. Short chain fructo-oligo saccharides (sc-FO) have been investigated, however a beneficial effect on insulin sensitivity in these horses could not be shown consistently in all studies[18]

## CONCLUSION

In conclusion there is currently weak evidence for the use of probiotics to prevent or treat gastrointestinal disease in horses, and limited evidence for probiotic products to enhance digestibility. Given the lack of quality control and questionable content of commercial products it is doubtful whether any effects can be achieved. Care has to be taken with self-manufactures products, particularly in foals as negative effects have been reported. Supplements have to be divided into vitamin and mineral supplements for horses with a true lack of such in the diet and such where these would be fed in addition. If there is a lack of a particular vitamin or mineral due to deficiency of the soil, these should be added to the diet. Unfortunately companies have little incentive to perform research on their products, as studies are not required for marketing of the product and products sell well without results from such studies.

Clients of healthy horses are best advised to feed a balanced diet of forage supplemented with grain if the horse has high energy expenditures. As some vitamin and mineral deficiencies can be subclinical (not obvious) owners of high performance horses can also err on the side of caution and add a vitamin/mineral supplement to the diet. Clients of horses with specific diseases that are likely influenced by nutrition, such as PSSM, HYPP, Equine Metabolic syndrome, gastric ulcer disease, inflammatory bowel disease and others are best advised to seek advice from their veterinarian and follow their recommendations. There is no conclusive evidence in the current literature to support feeding commercial supplements as a prevention or treatment of diseases.

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